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ABSTRACT

In developing any Virtual University it is important to clarify the differences between organizational structure, technical infrastructure, and content. This paper introduces a model for virtual universities that consists of three layers. The organizational layer defines the structure of the organization and addresses issues such as copyright and quality assurance. The infrastructure layer is concerned with the underlying technology necessary for the delivery of courses and assessments over a virtual university. The content layer defines the format of the learning materials themselves. Each layer of the model has associated with it a number of issues. Virtual Universities must address all of these issues if they are to prove effective. Other issues will emerge in each of the three layers as Virtual Universities develop. (AEF)

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A Virtual University Model

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Abstract: The virtual university (VU) is a term used to describe a growing range of projects and enterprises, ranging from *clearing houses* listing a range of distance courses offered by more than one institution to the full scale *new institution* delivering its own fully accredited degree courses. In developing any virtual university it is important to clarify the differences between organisational structure, technical infrastructure and content. This paper examines the different types of organisation developing and proposes a three layer model for the virtual university.

1. The Model

This paper proposes a three layer model for virtual universities. Each layer of the model has, associated with it, a number of issues which will have to be addressed by any virtual university.

Organisational Layer	Infrastructure Layer	Content Layer
• Structure • Copyright • Quality assurance	• "Virtual Campus" - Look and feel • Registration and Payment • Student support services • Assessment mechanisms • Discussion mechanisms • Content delivery systems • Student tracking	• Static HTML • On the fly HTML • Learning environments • Formative assessments • Summative assessments

Table 1: The Virtual University Model

1.1 The Organisation Layer

1.1.1 Structure

A growing number of "virtual universities" have emerged since web technology began to be used extensively for education in 1995. These can be broadly classified under three categories: *virtual front ends* for single existing institutions, *collaborative ventures* involving genuine collaboration between existing universities, and entirely *new institutions* created for the delivery of online education. In addition there are two further types of website which call themselves virtual universities. Online *clearing houses* bring together the distance courses offered by a range of institutions. There are also various *commercial enterprises* that do not deliver accredited university courses.

All bricks and mortar universities now have a web presence. In most cases these pages are the gateway to information for staff and students giving and taking courses traditionally. Some institutions, such as Michigan State University (http://vu.msu.edu/) have chosen to create a *virtual front end* separate from their main university web server. This offers access to the online, distance courses delivered from the university, aimed at students who find traditionally delivered courses inconvenient. As increasing numbers of lifelong learners are drawn to higher education, and online learning forms a more significant part of the courses offered by existing universities, the distinctions between main web sites and *virtual front ends* are likely to blur. Universities such as the University of Phoenix (http://www.uophx.edu/) in the USA, and Britain's Open University

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(http://www.uophx.edu/) already delivering courses primarily by distance are likely to find this transition relatively painless.

The *collaborative venture* between existing universities is a model that combines the strength and credibility of more than one institution. Funding can be attracted more easily where several universities come together and resources are pooled for maximum impact. Clyde Virtual University (http://cvu.strath.ac.uk/) was one of the first joint projects to develop along these lines. Bringing together staff from four universities in Western Scotland, it has attracted national government funding since 1995. It currently provides online modules within traditionally delivered degree courses, accredited by the existing institutions. The Western Governors' University (http://www.westgov.org/smart/vu/vu.html) was founded in 1997 as a non-profit, independent institution bringing together the expertise of academic institutions across 16 states for the delivery of new courses, accredited by the new organisation rather than the existing universities.

A few entirely *new institutions* have been created to exploit the demand for distance learning. Notable among these is The International University (http://www.international.edu/). Based in Denver, Colorado, the Internet-based organisation has applied for accreditation from the Commission of Institutions of Higher Education of the North Central Association of Colleges and Schools. Such credibility is sorely lacking on some of the programs that have become known as "digital diploma mills" delivered by unaccredited organisations. Warnings such as that over Columbia State University (http://www.degree.net/news8/csualert.html) will not help quality new institutions to bridge the credibility gap.

There are several instances of the institutions within one geographical region combining information on their distance education provision within one web site and its associated organisational structures. Established by executive order of the Governor of California, after a decision to leave the Western Governors' University coalition, California Virtual University (http://www.california.edu/) contains links to the 45 accredited colleges and universities in California which currently offer distance courses. A similar website in Finland, the Virtual Open University of Finland (http://www.avoinyliopisto.fi/), lists the courses available at 19 Finnish Open Universities. Neither of these projects is set to evolve into a single cyberspace entity; indeed the philosophy (http://www.virtualu.ca.gov/welcome.html) behind the California Virtual University is specifically against the creation of a new bureaucracy competing with existing universities. One *clearing house* not linked to any particular region is the Globewide Network Academy (http://www.gnacademy.org/), which lists over 15,000 courses and programs Worldwide.

By no means "universities" in the sense that they do not offer accredited degree courses, some *commercial enterprises* such as Price Waterhouse Virtual University (http://www.vu.pw.com/), have built their own websites to meet the training needs of a single company.

1.1.2 Copyright Issues

Virtual Universities whatever their organisational structure must have clear policies on copyright and ownership of materials. This can become particularly problematic within *collaborative ventures* where online courses are often developed by several individuals from more than one institution. Who holds the copyright to the final product, the leading academic, the course team as a whole, the lead site, the consortium or a combination of these? The answer is that each party may have some claim to the copyright but that this depends on contracts of employment and the terms of the agreements which should be made before content is built.

1.1.3 Quality Assurance

As with the delivery of traditional higher education, a system needs to be put in place to assure the quality of Internet-based courses. Rigorous and regular testing and evaluation of materials and methodologies are necessary. A system designed to review curriculum, environment and resources, teaching and learning, assessment and standards of achievement, guidance and support is essential to ensure that standards of quality are upheld. California Virtual University has produced an extensive academic plan

(http://www.virtualu.ca.gov/Faculty/AcademicPlan/acplan-full.html) outlining the roles and responsibilities of each institution and detailing how quality will be assured in virtually-delivered courses.

1.2 The Infrastructure Layer

This is the layer which is often most visible when visiting a site. All large Web sites need a consistent and distinctive look and feel. VUs are no exception and many use the campus metaphor for at least the top level of navigation. The infrastructure of a VU must also include extensions to the basic Web server. Without the addition of registration systems, assessment mechanisms, discussion mechanisms and the like a VU would be no more than a document store. The extensions can be implemented as CGI programs, servlets or any other technology.

1.2.1 The Virtual Campus

A number of excellent examples of virtual campus front ends exist such as Clyde Virtual University (CVU) (http://cvu.strath.ac.uk/), Howard Community College (HCC) (http://www.howardcc.edu/) and FernUniversität (http://vu.fernuni-hagen.de/). Imagemaps are the usual way to implement these top level menus. The number of choices offered varies widely; at the time of writing, CVU offers a choice of five "buildings" in its virtual campus while HCC offers fifteen "buildings" along with other clickable street furniture such as a mailbox, a phonebox and road signs. The campus metaphor is rarely continued within the site where traditional navigation icons tend to take over.

Consistent navigation is necessary when content has been created by many authors with different backgrounds and probably with different ideas about how their material should look.

More advanced implementations of the campus metaphor, such as VRML, may provide something more immersive but could restrict the user base without alternative, lower technology, navigation mechanisms.

1.2.2 Registration and Payment

Linked closely with how the VU is organised, not all VUs will have to deal with virtual payment systems. All VUs will have to "identify" their students in one way or another and this implies the requirement for some form of registration. The management of the large amount of registration details that can be generated by just a small VU can be a major problem if not properly planned. Registries of traditional universities can absorb large amounts of resources and it is likely that even well planned and implemented VUs will still require what at first sight seems like a large amount of staff time relative to the amount of time spent on authoring the VU content.

1.2.3 Student Support Services

The student accommodation office may be redundant in the VU but counselling and advisory services may well be more important to the student who studies at a VU. How these services are organised and staffed must not be overlooked in the haste to capitalise on the economies of scale that a VU offers.

1.2.4 Assessment Mechanisms

Assessments, both formative and summative, are crucial to any educational experience. VUs have to offer a mechanism for testing student achievement. Formative assessments will almost certainly be integrated into the content of the courses. This might make the content less portable than it would otherwise be but the advantages of tight integration of content and formative assessment are many.

Summative assessments can also be delivered from a VU but problems of user authentication and plagiarism become very important. It would be possible to deliver a traditional exam via the Web only if the students were in a room of computers under traditional exam conditions. A move toward innovative methods of summative assessment is, in some respects, desirable so long as academic quality is not compromised.

1.2.5 Discussion Mechanisms

Student-student, staff-student and also staff-staff contact has to be supported in some way. In an online environment the simplest discussion mechanism might be email, but this is not very sophisticated. Basic email systems can be improved dramatically by adding mailing list managers and mail archives. Email can then easily be targeted at particular groups of students and a permanent record can be kept of all email exchanged within the student group. Systems such as WWWBoard (http://worldwidemart.com/scripts/wwwboard.shtml) and HyperNews (http://www.hypernews.org/) provide a Web-based alternative to email lists for asynchronous discussions. Sophisticated, non Web-based (but, more recently, Web accessible) systems such as Lotus Notes (http://www.hypernews.org/) and FirstClass (http://www.softarc.com/) are widely used for asynchronous discussions. Synchronous or "real time" discussions can be supported by Internet Relay Chat, EWGIE (http://www.eit.com/ewgie/) and various other systems.

1.2.6 Content Delivery Systems

If the course material, which will be discussed in the content layer, is stored as something other than HTML then some mechanism for generating Web pages on-the-fly is required.

1.2.7 Student Tracking

Monitoring students' progress is important in any university, VUs are no exception. Results from formative and summative assessments will provide vital data but tracking students' progress through the content may also provide useful information. Most Web servers will log access information. Analysing the server's log file to provide useful information regarding individual students remains a challenge.

1.2.8 Integrated Systems

Many systems are now available which integrate a number of the functions of the infrastructure layer (http://www.wbtsystems.com/, http://homebrew.cs.ubc.ca/webct/). Basic systems help automate the authoring and delivery of Web-based content and might include assessment and discussion mechanisms. More advanced systems will take care of student registration and payment, user tracking and content organisation and offer an attractive front end to the courses. Comparative analyses and critical reviews of integrated learning packages are available on the Web (http://node.on.ca/tfl/integrated/eye/).

1.3 The Content Layer

Web-based courses are the reason VUs exist. Many VUs have developed from simple collections of course material. As the range and number of courses increases, the need to impose some sort of structure becomes ever more pressing. The organisation of the content will depend largely on the type of institution. The way the content is authored, stored and delivered to the student could be any of a number of options available. As the content will probably be provided by many different authors it is quite possible that different courses will be authored, stored and delivered in different ways on the same VU.

1.3.1 Static HTML

Web-based courses will probably have started life as a collection of HTML pages, perhaps with a few inline images. For the author this is relatively easy to produce, perhaps using an HTML authoring tool such as HotMetal (http://www.softquad.com/products/). Although simple and straightforward, static HTML does have problems. Maintaining a site's consistent look and feel can be very difficult when authors are creating their own HTML. The quality of the HTML can vary greatly (using an HTML authoring tool is no guarantee that the HTML produced is correct). The rigorous use of an HTML validator is recommended. Use of discussion areas and formative assessments within the course requires the careful integration of pages generated by CGI programs.

1.3.2 On The Fly HTML

Given the need for some of the CGI generated pages within the content it is worth considering the "on the fly" generation of all the content. Control over the look and feel is taken away from the author and consistency is guaranteed. Linking in discussion areas and formative assessments becomes trivial. However, authors are now forced to use a particular authoring tool such as Toolbook II (http://www.asymetrix.com/products/) and the portability (and reusability) of the material is lost. Authors are also constrained by the limitations of the chosen delivery system, while innovative use of technologies such as Java and VRML might be difficult if not impossible.

1.3.3 Learning Environments

Organising information into sequences of Web pages with added discussion areas and formative assessments produces adequate but not particularly engaging Web-based courses. A more imaginative approach, that can be usefully mixed with the basic approach, is to challenge students with a task which has to be accomplished within a virtual environment. These environments could make use of VRML and simulation engines to provide truly interactive learning environments in which groups of students could hone their skills.

1.3.4 Formative Assessments

The design of well graded formative assessments can provide vital feedback to students who may be isolated from any human feedback. The design and delivery of multichoice and multiresponse questions is well documented (http://www.qmark.com/). Multichoice style questions can be quite limiting in nature and it may be useful to have a wider range of question types available. Integrating Java Applets with an assessment mechanism allows for a much wider variety of question types including drag and drop and questions which encourage critical self assessment (http://cvu.strath.ac.uk/admin/cvudocs/caa2lboro/).

2. Conclusions

This paper has introduced a model for virtual universities that comprises of three layers. The organisational layer defines the structure of the organisation and addresses issues such as copyright and quality assurance. The infrastructure layer is concerned with the underlying technology necessary for the delivery of courses and assessments over a virtual university. The content layer defines the format of the learning materials themselves. Each layer of the model has associated with it a number of issues. All VUs must carefully address all of these issues if they are to prove effective. Others issues will emerge in each of the three layers as VUs develop.